

**TRANSPORT CANADA/FAA SIMULATOR EVALUATION
BOMBARDIER AEROSPACE TRAINING CENTRE
MONTREAL, CANADA
NOVEMBER 16, 2004**

An evaluation of the CRJ-200 simulator was conducted on November 16, 2004 at the Bombardier Aerospace (BA) Training Centre in Montreal Canada by two certification authority test pilots. The purpose of the evaluation was for both Transport Canada and FAA test pilots to re-familiarize themselves with the CRJ-200 and to observe simulator performance, handling qualities, systems, and procedures related to the recent CRJ-200 accident incurred by Pinnacle Airlines on October 14, 2004.

This evaluation was done in conjunction with a National Transportation Safety Board (NTSB) meeting in Montreal, however, it was not part of the NTSB proceedings. It was instead an independent effort by both certification authorities for the purposes stated above.

The FAA test pilot, Rod Huete occupied the left seat and flew the simulator while the TCCA test pilot, Don Stephen, occupied the right seat, recorded data and orchestrated the tests. A BA Training Centre company pilot, Jaques Nadeau, operated the simulator. There were two FAA observers: TR Proven from the FAA Office of Accident Investigation (AAI) Washington, D.C. and Jim Delisio from the New York Aircraft Certification Office (NYACO).

The test profile included the following events:

1. Duplication of the Pinnacle Airlines engine start ground tests conducted on a company aircraft on November 4, 2004.
2. Performance stall to pusher at 15,000 ft MSL.
3. A climb to FL 410 using the recommended climb schedule.
4. A climb to FL 410 using the accident profile
5. A stall to pusher at FL 410 with no pilot intervention on the recovery from pusher activation.
6. A stall to pusher at FL 410 with pilot intervention on the recovery from pusher activation similar to what was observed in the Flight Data Recorder (FDR).
7. A dual engine flameout at FL 410 using company checklist airspeeds and procedures (including engine airstart attempts)
8. A dual engine flameout at FL 410 using airspeed/altitude data observed from the FDR (including engine airstart attempts).

The results of the test and test data is presented in the attached log.

SUMMARY OF RESULTS

The simulator faithfully duplicated the engine start ground tests conducted by Pinnacle Airlines.

The performance stall to pusher at 15,000 ft showed no unexpected results. The recovery from pusher activation with no pilot intervention returned the aircraft to a controlled flight condition with a slight nose low attitude.

The climbs to FL 410 uncovered two possible simulator-to-aircraft discrepancies:

- a. The simulator appears to have less drag at FL 410 than the aircraft. At 165 KIAS, the Pinnacle accident FDR shows that with a 94% N1 setting, the aircraft was decelerating in level flight. In the simulator, at 94% N1, the aircraft was accelerating and would not decelerate until an N1 of approximately 87.5 % was set.
- b. During the climb, an uncharacteristic airframe buffet was felt starting at 39,800 ft and continued throughout the climb. This buffet onset was also observed during the climb using the Pinnacle profile at the exact same altitude. According to BA Flight Sciences, airframe buffet should not be felt before stick shaker at this altitude.

The stalls to pusher at FL 410 uncovered another possible simulator-to-aircraft discrepancy. The pusher activation produced a full throw of the yoke. This is considered uncharacteristic of the actual aircraft due to the fact that the negative alpha dot algorithm would likely cancel the pusher prior to full yoke deflection in the aircraft. In the aircraft, at these altitudes, the pusher activation is usually only momentary and does not result in a full yoke deflection. It is suspected that the simulator may not accurately reflect the alpha dot pusher cancellation at these altitudes. This may explain why both Flight Safety and CAE simulators exhibit self-induced pusher ON pusher OFF characteristics.

During review of expected stick shaker and low speed awareness (top of red band on the airspeed display) by BA Flight Sciences for the accident conditions at stall, the data shows that the shaker will activate at approximately 10 KIAS above the low speed awareness speed. The simulator confirmed this discrepancy, although it only showed a seven knot difference. This difference could be caused by the change of shaker and pusher angles of attack (AOA) as a function of Mach number. At higher Mach numbers, the shaker/pusher activation AOAs are lower (higher speeds) with the break occurring above approximately 0.52 M.

RECOMMENDATIONS

Simulator Fidelity. Bombardier Aerospace needs to determine if the appropriate aerodynamic and Stall Protection Computer (SPS) data was included in the simulator data package provided to CRJ-200 simulator manufacturers in the following areas:

1. Aerodynamic performance (Thrust/drag) at high altitudes above 37,00 ft MSL.
2. Perceivable aerodynamic buffet above 39,800 ft MSL.
3. Stick pusher cancellation term at high altitudes.

Aircraft Design. Bombardier Aerospace needs to revise the airspeed tape low speed awareness display software to coincide with stick shaker activation at high altitudes and all Mach numbers.

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Atch: Simulator Log
